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EXTENDING GRAZING IN HEIFER DEVELOPMENT SYSTEMS DECREASES COST WITHOUT COMPROMISING PRODUCTION

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ABSTRACT: Three experiments compared heifer development systems. In Exp. 1, 299 heifers (253 ± 2 kg) from 3 yr were used to compare dry lot (**DL**) to grazing corn residue (**CR**) post weaning. Heifers in the DL consumed a common diet after weaning for 187 d until breeding. The CR heifers grazed for 145 d with a supplement (0.45 kg/d; 28% CP) and were then fed in the DL until breeding. In Exp. 2, 270 heifers (225 ± 2 kg) in 3 yr grazed Sandhills winter range (**WR**) or CR with a supplement (0.45 kg/d; 28% CP) post weaning. In Exp. 3, 180 heifers (262 ± 3 kg) in 2 yr grazed Eastern Nebraska WR or CR with a supplement (0.45 – 0.90 kg/d; 29% CP) post weaning. The CR heifers had lower ($P < 0.001$) ADG before breeding compared to DL or WR heifers in Exp. 1 and 2, but WR and CR were similar ($P = 0.66$) in Exp. 3. The DL and WR heifers were heavier ($P < 0.003$) than CR at breeding and pregnancy diagnosis in Exp. 1 and 2, but similar ($P = 0.62$) in Exp. 3. The percentage of heifers pubertal at breeding was greater ($P < 0.001$) for DL than CR in Exp. 1, for WR than CR in yr 1 and 2 of Exp. 2 ($P < 0.01$), but similar ($P = 0.36$) in Exp. 3. Pregnancy rate to AI was lower ($P = 0.08$) for CR than DL heifers in Exp. 1, but not different ($P = 0.89$) in Exp. 3. Final pregnancy rate was not affected ($P \geq 0.27$) in Exp. 1, 2 or 3. In Exp. 2,, yr 2, CR heifers required ($P = 0.01$) more calving assistance than WR. Milk production of WR heifers was greater ($P = 0.04$) than CR in Exp. 3. Calf weaning BW, two-year old AI (Exp. 1 and 3) and final pregnancy rates (Exp. 1, 2 and 3) were not different ($P > 0.10$). Development grazing CR reduced cost by $45/pregnancy compared to DL, but cost of WR was similar to CR. Development grazing CR reduces ADG before breeding without sacrificing final pregnancy rate. Development grazing WR increases milk production, but does not increase weaning BW. Grazing CR during heifer development reduces cost compared to DL. Grazing CR or WR is suitable for heifer development at similar cost.

Key Words: Dormant forage, Drylot, Heifer development

Introduction

Current recommendations indicate a heifer should reach approximately 65% of her mature BW by the first insemination for successful reproduction (Patterson et al., 1992). Prompted by rising input costs, there is increasing interest in alternative heifer development systems minimizing the use of harvested feedstuffs in favor of grazing. However, dormant forages are lower in available nutrients and may result in poorer animal performance leading to lower BW at breeding. Recent data indicate heifers reaching less than 58% of mature body weight by breeding have similar reproductive ability as heavier counterparts (Funston and Deutscher, 2004; Martin et al., 2008). Moving heifer development out of the dry lot (**DL**) in favor of grazing standing forage may be more cost effective. As corn production increases, so does the availability of corn residue (**CR**) for grazing. Winter range (**WR**) offers a similar source of standing winter forage for heifer development. The effects of developing virgin heifers using standing winter forage are not well characterized. Therefore, the current studies evaluated the effect of grazing CR compared to DL or WR on first service conception rate, pregnancy rate, and first calf production characteristics.

Materials and Methods

The University of Nebraska-Lincoln Institutional Animal Care and Use Committee approved the procedures and facilities used in these experiments.

Experiment 1. Two hundred ninety-nine crossbred nulliparous heifers (253 ± 2 kg initial BW) from 3 production yr were utilized to compare traditional post weaning DL development to grazing CR during the same period. The heifers in these experiments were predominately black Angus based and purchased from local producers shortly after weaning from their dams.

Following weaning, heifers were transported to the University of Nebraska West Central Research and Extension Center (**WCREC**), North Platte, NE. After a receiving period, heifers were blocked by initial BW and randomly assigned to graze CR or consume a diet in a DL. Heifers assigned to graze CR were shipped to corn fields on approximately November 15 and returned to WCREC between February and April each yr as dictated by weather conditions. Heifers were offered 0.45 kg/d of a 28% CP (DM basis) supplement daily. Heifers grazed CR for approximately 145 d each yr. Subsequently, heifers were transported back to WCREC, placed in the DL and offered a common diet for 42 d each yr. Heifers assigned to the DL treatment were offered a common diet after the weaning period for 187 d each yr until breeding. The DL diet was formulated to achieve an ADG allowing heifers to reach approximately 65% of mature BW (600 kg) prior to AI.

In yr 1, estrus was synchronized using MGA/PGF followed by timed AI (TAI). In yr 2 and 3, estrus was synchronized using MGA/PGF followed by estrous detection and AI. After AI, heifers were exposed to fertile bulls at a rate of least 1 bull:50 heifers for 45 d. Approximately 45 d after AI, first service conception was determined via transrectal ultrasonography and final pregnancy rate was determined via transrectal ultrasonography 45 d after bulls were removed.

After pregnancy diagnosis, heifers were managed in one group until calving. During the subsequent winter period, all pregnant heifers grazed CR and were offered the equivalent of 0.45 kg/d of a 28% CP (DM basis) supplement provided 3 times per wk. All heifers were weighed prior to calving and calf birth date, birth BW, dystocia score, and sex were recorded at birth.

After calving, all heifers consumed a DL diet through AI breeding. Approximately 60 d after calving, estrus was synchronized using CIDR/PGF followed by timed AI. After AI, heifers were sold to local producers and grazed common summer pastures until weaning. After being sold, all cows were exposed to fertile bulls for a period not less than 45 d. Approximately 45 d after TAI, first service conception was assessed via transrectal ultrasonography. At weaning, final pregnancy rate was determined via transrectal palpation or ultrasonography and calf BW was collected. The data were analyzed using the MIXED and GLIMMIX procedures of SAS.

Experiment 2. Experiment 2 was conducted using heifers from the Gudmundsen Sandhills Laboratory (**GSL**) near Whitman, NE. Composite Red Angus × Simmental weaned heifer calves (n = 270) were assigned randomly by initial BW (225 ± 2 kg) to graze either CR or WR between weaning and the beginning of the breeding season. Grazing treatments were initiated approximately 30 d after weaning, beginning in mid-November, and continuing through mid May each yr. Heifers either grazed winter range pastures at GSL or were transported to corn residue fields on approximately November 15th and returned to GSL on approximately February 15th each yr. A daily supplement was offered (0.45 kg/hd; 28% CP) while grazing. Subsequently, all heifers grazed WR for 100 d prior to breeding with a daily supplement (0.45 kg/hd; 28 % CP) until breeding. Estrus was synchronized with a single i.m. injection of $PGF_{2\alpha}$ administered 108 h after bulls were turned in with the heifers. Heifers were exposed to fertile bulls (1:25; bull:heifer) for 45 d. Pregnancy diagnosis was performed via transrectal ultrasonography approximately 45 d following completion of the breeding season. During the breeding season and until pregnancy diagnosis, heifers grazed upland summer Sandhills range in a single group. After pregnancy diagnosis, non-pregnant heifers were sold.

In the period between pregnancy diagnosis and calving, pregnant heifers grazed upland Sandhills range during the fall until November 15th and then grazed CR during the winter with a supplement (0.45 kg/d, 28% CP) until February 15th. Approximately 2 wk prior to calving, pregnant heifers were weighed and BW recorded. At calving, calf birth date, birth BW, dystocia score, and sex were recorded. At weaning, cows and calves were weighed and BW was recorded. The data were analyzed using the MIXED and GLIMMIX procedures of SAS.

Experiment 3. Experiment 3 was conducted at the Agricultural Research and Development Center near Mead, NE. Composite MARC III x Red Angus weaned heifer calves (n = 180) were assigned randomly by initial BW (262 ± 3 kg) to graze either CR or WR between weaning and breeding. Grazing treatments were initiated approximately 30 d after weaning, beginning in mid-November, and continuing through mid-February (119 d) each yr. A daily supplement was offered (0.45 – 0.90 kg/d; 29% CP) while grazing. Subsequently, all heifers grazed WR for 100 d prior to breeding with a daily supplement (0.45 kg/hd; 28% CP). In addition to grazing, free choice brome hay (13% CP, 42% ADF; DM basis) was offered as weather conditions dictated.

Estrus was synchronized using two i.m. injections of $PGF_{2\alpha}$ administered 16 and 2 d prior to AI breeding. Following the second $PGF_{2\alpha}$ injection, estrus was detected for at least 5 d. Heifers were inseminated approximately 12 h after estrus was detected. Fourteen d after AI, fertile bulls were turned in with the heifers at a ratio of 1 bull:50 heifers. Bulls remained with the heifers for 45 d. Pregnancy to AI was determined via transrectal ultrasonography approximately 45 d after AI. Final pregnancy rate was determined via transrectal ultrasonography 45 d after bulls were removed.

Following pregnancy diagnosis, pregnant heifers were managed in a single group until calving. During this period, pregnant heifers grazed CR with a daily supplement (1.2 kg/d; 10.5% CP). Two wk prior to calving, pregnant heifer BW was measured. At calving, calf birth date, birth BW, dystocia score, and sex were recorded. Between calving and the time when spring pasture was available for grazing, heifers consumed free choice alfalfa/grass hay with a daily supplement (1.2 kg/d; 10.5% CP; DM basis). Approximately 65 d after calving, milk production was estimated using a weigh-suckle-weigh technique. Cow and calf BW were collected at weaning. Data were analyzed using the MIXED and GLIMMIX procedures of SAS.

Results and Discussion

Heifer gain and reproduction data for Exp. 1, 2 and 3 are summarized in Table 1. Heifers grazing CR gained 0.39 kg/d less ($P < 0.001$) than heifers in the DL in Exp. 1 and 0.10 kg/d less ($P < 0.001$) than heifers grazing WR in Exp. 2 during the winter grazing period. Heifers grazing CR in Exp. 3 gained 0.06 kg/day less ($P = 0.002$) than heifers grazing WR. In Exp. 1 and 2, heifers grazed with minimal hay supplementation; however snow cover necessitated more extensive hay feeding in Exp. 3. The ADG during the entire prebreeding phase reflects hay feeding, where heifers grazing CR gained less ($P < 0.001$) than heifers in the DL or grazing WR in Exp. 1 and 2, respectively. However, prebreeding ADG was not different ($P = 0.66$) in Exp. 3. Prebreeding BW was related to prebreeding ADG, where heifers grazing CR were lighter ($P < 0.001$) prior to breeding compared to heifers in the DL (Exp. 1) or grazing WR (Exp. 2). However, prebreeding BW was similar ($P = 0.62$) in Exp. 3. The CR heifers in Exp. 1 were 56% and DL heifers 65% of mature BW before breeding. In Exp. 2, CR developed heifers were 52% and WR heifers 55% of mature BW at breeding. In Exp. 3, CR and WR heifer were approximately 62 to 63% of mature BW at breeding. A summary of previous data indicated heifers should reach 65% of mature BW before breeding for successful reproduction (Patterson et al., 1992). However, data from our group (Funston and Deutscher, 2004; Martin et al., 2008) demonstrate pregnancy rate, through 4 yr of age is not reduced by developing heifers to less than 53% of mature BW. Likely, due to decreased prebreeding BW, fewer ($P < 0.001$) heifers grazing CR were pubertal before breeding compared to DL heifers in Exp. 1 and compared to WR heifers in yr 1 and 2 of Exp. 2. However, a similar ($P = 0.36$) percentage of heifers from each treatment were pubertal at AI in Exp. 3.

In Exp. 1, AI pregnancy rate was 10% lower ($P = 0.08$) in CR heifers compared to DL heifers, possibly due to pubertal differences. However, AI pregnancy rate was similar ($P = 0.89$) in Exp. 3. Regardless of percentage of pubertal heifers, final pregnancy rate was similar ($P \geq 0.27$) in Exp. 1, 2, and 3. Genetics may have minimized the negative effect of estrous cycle number on pregnancy rate. Byerly et al. (1987) indicated the first estrous cycle a heifer undergoes is less fertile than the third. Cushman et al. (2007) demonstrated that the number of estrous cycles prior to breeding experienced by the first calf heifer is not related to pregnancy rate.

Prior to calving, the CR heifers were still lighter ($P = 0.01$; Exp. 1) than DL heifers, although precalving BW was not different ($P \geq 0.16$) in Exp. 2 and 3. Although lower prebreeding BW may have reduced AI pregnancy rate, the percentage of heifers that calved in the first 21 d of the season was not different ($P \geq 0.20$) between CR and DL (Exp. 1) or CR and WR (Exp. 2 and 3; Table 2). Similar to the percentage calving early, average calf birth date was also not different ($P \geq 0.13$) in Exp. 1, 2 and 3, as were calf birth BW ($P \geq 0.16$) and the percentage of male calves ($P \geq 0.17$). A primary concern associated with this system is an increase in calving difficulty due to lighter heifers at calving. The percentage of heifers requiring calving assistance was not different ($P \geq 0.15$) in Exp. 1 and 3. However, in yr 2 of Exp. 2, 34% more ($P = 0.01$) CR developed heifers required calving assistance than WR developed heifers.

Pregnancy rate to AI in the second breeding season was similar ($P \geq 0.61$) in Exp. 1 and Exp. 3 (Table 1). Final pregnancy rate after the second breeding season was also similar ($P \geq 0.37$) between treatment groups in Exp. 1, 2 and 3. Apparent milk production was measured in Exp. 3 (Table 2). The WR developed heifers produced more milk ($P = 0.04$) at approximately 65 d post calving than heifers developed grazing CR. However, neither calf weaning BW ($P \geq 0.44$) or calf adjusted 205 d BW ($P \geq 0.31$) were different among treatments in Exp. 1, 2 or 3. These data agree with previous research conducted by Funston and Deutscher (2004) and Martin et al. (2008) who indicate that although heifers developed to 50% of mature BW at breeding are lighter through the third breeding season, long term reproduction and calf production are not impacted.

Previous data (Funston and Deutscher, 2004; Martin et al., 2008) demonstrate substantial cost reductions from lower gain heifer development. These previous studies were conducted with heifers developed in the drylot targeted for lower rates of gain. Thus, developing heifers using dormant, standing forage may further reduce cost. Non-pregnant heifers developed grazing standing forage are lighter at pregnancy diagnosis than traditionally developed heifers and will be better suited for a long-yearling feedlot program. Cull heifers are considered an additional source of revenue in this system. Developing heifers by grazing CR reduced winter feed cost by $42/heifer compared to development in the dry lot (Table 3). In addition, slightly more CR heifers were not pregnant after breeding, increasing the value of culled heifers. After considering feeding cost and cull value difference, CR development reduced the net cost of developing one pregnant heifer by $45 compared to DL development. However, as WR and CR are charged to the development system at a similar cost and pregnancy rates were similar, developing heifers on CR or WR resulted in little difference in the cost of developing a pregnant heifer.

Implications

Winter development using corn residue is a suitable alternative to winter range or a dry lot. The reduction in the percentage of pubertal heifers developed grazing corn residue may reduce AI conception, but final pregnancy rate is similar. The factors that mediate these effects are complex; however, developing heifers using corn residue does not negatively influence long-term production. Developing heifers by grazing dormant forage reduces cost compared to dry lot feeding, improving sustainability.

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Table 1. Effect of winter system on gain and reproduction in heifers, Exp.1, 2 and 3

	Treatment											
	Exp. 1[1]			Exp. 2[2]			Exp. 3[3]			*P*-values		
Item	DL	CR	SEM	WR	CR	SEM	WR	CR	SEM	Exp.1	Exp.2	Exp.3
n	150	149		136	134		90	90				
Pre-breeding BW, kg	387	336	4	298	244	2	313	308	3	<0.001	<0.001	0.62
Percentage of mature BW	65	56	1	55	52	1	63	62	1	<0.001	<0.001	0.62
Pregnancy diagnosis BW, kg	444	416	5	359	349	2	420	416	4	<0.001	0.003	0.44
ADG during grazing, kg/d[4]	0.58	0.19	0.01	0.24	0.14	0.01	0.43	0.37	0.01	<0.001	<0.001	0.002
Prebreeding ADG, kg/d[5]	0.68	0.42	0.01	0.38	0.29	0.01	0.54	0.55	0.01	<0.001	<0.001	0.66
ADG from breeding to pregnancy diagnosis, kg/d	0.47	0.67	0.08	0.67	0.73	0.01	0.46	0.41	0.02	<0.001	<0.001	0.05
Pubertal by AI, %	88	46	4	-	-	-	57	63	5	<0.001	-	0.36
Year 1	-	-	-	73	33	7	-	-	-	-	<0.001	-
Year 2	-	-	-	77	61	8	-	-	-	-	<0.001	-
Year 3	-	-	-	49	58	7	-	-	-	-	0.003	-
Pregnant to AI, %	64	54	8	-	-	-	43	44	5	0.08		0.89
Yearling pregnancy, %	94	92	5	85	84	3	83	89	4	0.37	0.85	0.27
n	88	75		72	75		24	26				
Precalving BW, kg	446	428	5	444	440	4	469	461	4	0.01	0.33	0.16
AI pregnant, 2-year old, %	62	66	6	-	-	-	61	56	10	0.61	-	0.75
Pregnant, 2-year old, %	87	81	5	85	77	7	92	100	6	0.39	0.37	0.98

[1] DL = developed in the dry lot, CR = developed on corn residue (145 d) and fed in the dry lot (42 d) before AI.
[2] WR = developed on winter range, CR = developed grazing corn residue (100 d) and grazed winter range (100 d) before breeding.
[3] WR = developed on winter range, CR = developed grazing corn residue (120 d) and grazed winter range (100 d) before AI.
[4] ADG during the winter grazing period; [5] ADG after the winter grazing period prior to breeding

Table 2. Effect of winter system on calf production, Exp.1, 2 and 3

	Treatment											
	Exp. 1[1]			Exp. 2[2]			Exp. 3[3]			*P*-values[2]		
Item	DL	CR	SEM	WR	CR	SEM	WR	CR	SEM	Exp.1	Exp.2	Exp.3
n	88	75		72	75		24	26				
Calved in 1st 21 d, %	84	76	11	83	75	5	81	74	5	0.20	0.24	0.32
Calf birth date, Julian d	71	74	3	67	69	1	76	75	3	0.13	0.37	0.75
Calf birth BW, kg	35	34	1	32	33	1	33	35	1	0.16	0.35	0.17
Assisted births, %	26	33	5	-	-	-	8	22	8	0.33	-	0.15
Year 1	-	-	-	37	28	8	-	-	-	-	0.40	-
Year 2	-	-	-	13	47	9	-	-	-	-	0.01	-
Sex, % male	55	48	3	49	55	6	84	73	6	0.41	0.43	0.17
Milk production, kg/24 h[4]	-	-	-	-	-	-	4.1	2.9	0.6	-	-	0.04
Calf weaning BW, kg	193	197	5	178	181	4	220	226	5	0.49	0.59	0.44
Calf 205 d BW, kg	180	186	4	195	197	3	215	219	5	0.31	0.59	0.51

[1] DL = developed in the dry lot, CR = developed grazing corn residue (145 d) and fed in the dry lot (42 d) before AI.
[2] WR = developed on winter range, CR = developed grazing corn residue (100 d) and grazed winter range (100 d) before breeding.
[3] WR = developed on winter range, CR = developed grazing corn residue (120 d) and grazed winter range (100 d) before AI.
[4] Measured using a modified weigh-suckle-weigh technique approximately 65 d post calving.

Table 3. Effect of winter system on heifer development cost , Exp.1, 2 and 3

	Treatment								
	Exp. 1[1]			Exp. 2[2]			Exp. 3[3]		
Item	DL	CR	Diff	WR	CR	Diff	WR	CR	Diff
n	150	149		136	134		90	90	
Feeding cost, $/heifer	237	195	-42	124	123	-1	128	121	-8
Total development cost, $/heifer	982	941	-41	832	838	6	853	848	-5
Cull heifer value, $/heifer exposed	53	77	-24	131	135	4	160	104	-56
Net cost of 1 pregnant heifer, $	985	940	-45	821	832	11	831	835	4

[1] DL = developed in the dry lot, CR = developed grazing corn residue (145 d) and fed in the dry lot (42 d) before AI.
[2] WR = developed on winter range, CR = developed grazing corn residue (100 d) and grazed winter range (100 d) before breeding.
[3] developed on winter range, CR = developed grazing corn residue (120 d) and grazed winter range (100 d) before AI.